STEM Faculty Learning Community

College of Natural Sciences and Mathematics

Spring 2013 Cohort Final Report

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Summary of Reports

Dr. Yohannes Abate was interested in understanding the source of students' misconceptions in fundamental concepts in his 140-people General Physics class (**Physics 100A**). To gain such insights, he was convinced that a careful assessment with a variety of tools was necessary. In particular, he selected problems from the Physics' Force Concept Inventory to design appropriate in-class exercises and out-of-class assignments through the mediums of group quizzes, iClicker questions, exams, and social homework platform. He collected raw responses from these instruments and performed scantron item analyses to help him answer two questions that he raised: (1) Do students have more difficulty in learning concepts or solving problems? (2) Why do students develop misunderstandings and why such misconceptions persisted even after repeated instructor interventions? What he found out through the analyses was that students had a hard time with problems that require the use of equations that are derived from fundamental physics concepts and problems that require comparisons. This was an eye-opening experience for Dr. Abate. He was fully convinced that a thoughtful design of assessment prior to instruction is essential to a meaningful learning experience for students and determined to adopt such practice in his future classes.

In *Marine Ecological Processes* class (**OSI 455**), **Dr. Bengt Allen** adopted an NSF-funded project, C.R.E.A.T.E. (Consider, Read, Elucidate the hypotheses, Analyze and interpret the data, and Think of the next Experiment) to promote the development of scientific thinking, data interpretation, and content knowledge for students who major in Marine Biology. During a short 4-week period, a 17% gain in students' ability to summarize and evaluate research ideas on two historically challenging papers, evaluated against a well-designed rubric, were observed. Moreover, students self-reported an improved ability to analyze scientific work critically and an increased understanding as to what it means to do scientific research. For Dr. Allen, the CNSM FLC pushed him to try something new to improve student learning and gave him the resources for doing so. He plans to adopt a similar approach in the *Ecology of Marine Communities* (BIOL 455) class and create an Ecological Concept Inventory to assess student learning in a large lecture general biology class (BIOL 350) in the upcoming semesters.

In General Genetics (**BIOL 370**), **Dr. Judy Brusslan** made a series of problem-solving videos to enhance student learning of difficult concepts. As the semester progressed on, she noticed an increasing number of students were viewing her videos and requesting for more videos on other topics. When she cross examined students' viewing data and exam scores, she noticed that video viewers had consistently higher scores on four pre-selected exam problems that were deemed challenging. That difference ranges from 1.39 to 6.06 percentage points. Overall, she found the resources provided in the FLC useful and she was motivated to try new technology and consistently consider assessment. The process of video-making helped her to understand students' time constraints as well as to think about different tools that students would consider most useful. As far as making the videos, that is a keeper.

Dr. Will Murray asked his Calculus II Honors (**MATH 123H**) students to give lectures on pre-selected topics with the intention to increase students' engagement with the materials and overall understanding of the topics. Along with the use of online homework, the pass rate of the course was 80.7% (21 in 26) in contrast to the average pass rate of 70.1% when the class was taught in 2004 and 2005. Seeing the reactions of his students before, during, and after those lectures, he realized that more cares should have been given in preparing students for such activities. Having made this change to his normal teaching routine, it allowed Dr. Murray to recognize that some experiments will succeed while some will likely to fail; however, we can learn from both and take good ideas and suggestions from both. More specifically, he realized how much our current student population is different from that of ten years ago. He is excited to try more ideas suggested in the online readings and by his fellow FLC participants in future classes.

Dr. Nate Onderdonk replaced a third of his traditional lectures in Introduction to Geomorphology (**Geol 339**) with flipped classes. Quantitatively, this resulted in increased average scores on the pertinent exams. While this increase may be due to the superior quality of the students this time around, he noticed an undeniable difference in the depth of conceptual understanding between two mechanisms of content delivery. In particular, by providing more targeted instructions for students who struggle with the concepts during class, students not only gain a better understanding of those concepts but become more fluent in applying these concepts in novel settings. For that, Dr. Onderdonk has successfully accomplished what a flipped classroom is aimed to alter: the depth of conceptual understanding. For Dr. Onderdonk, who constantly makes modifications to increase the impact of his teaching and student learning outcomes, FLC provided valuable ideas to facilitate this process.

Dr. Michael Peterson aimed to use Social Homework, an instructional platform that was developed by a group of physics professors on campus, to increase students' abilities to do quantitative and critical reasoning in his large lecture Electricity and Magnetism (**PHYS 152**) class. Despite the technical glitches of the system, a majority of the students appreciated the opportunity to do team work and felt that the Social Homework problems added a great value to the course. To his surprise, Dr. Peterson noticed in the course of solving these problems that some students were capable of performing at a level beyond his expectations. To this end, he believes that the social homework platform serves as a canvas for students' creativity and allows them to become seasoned problem solvers through collaborative work. Although an aggregated result on the effect of the system is not yet available, Dr. Peterson is convinced that the idea of Social Homework brings positive values to the existing course and will be implementing it in his upcoming PHYS 152 honor's class. Overall, Dr. Peterson liked the fact that FLC provides a medium for the avid teachers to share and contribute ideas on best practices of teaching and learning.

Dr. Houng-Wei Tsai used an online chat room feature on Beachboard (Collaborate) to hold six virtual office hours in Introduction to Ecology and Physiology (**BIOL 213**). The goal was to maximize instructional support for students during off-grid hours and increase the amount of teacher-student interactions. When he noticed that students were not taking advantage of this alternative way to conduct Q&As, Dr. Tsai researched possible reasons for such poor turnout and observed that a more timely advertisement may have increased students' participation level. Dr. Tsai plans to continue to improve the way of administrating online office hours together with traditional office hours.

Name: Yohannes Abate
Department: Physics and Astronomy
Name and number of class where development occurred: Physics 100 A, General Physics
Number of students in the class: 140
Is this typically considered a low completion rate course: No
Brief (few sentences) description of what it is that you tried and how you thought it might increase student learning/success/retention. If you tried several things, organize as best you can to be clear.

This semester I tried two important methods that resulted from FLC discussions and informal discussions with other faculty colleagues. The first one and what I consider to be the most important practice I have developed is the use of careful assessment. I am thankful to Dean Kingsford for seriously suggesting to me this concept in my mini reviews. Effective assessment really works and I am convinced that it improves teaching. The second one is peer instruction, this is something I have been doing prior to FLC, what is new is Social homework activity I tried this semester for the first time. In combination with other methods I employed including Iclickers and group in class quizzes, Social Homework was a very effective practice that I came to know this semester. It does not only allow student interaction but also offers excellent media for assessment. Because the data is there to stay together with the questions asked, one can come back and forth to extract important information on what students learn and not learn.

Results. Did it work? Did it now work? Briefly describe your results- ideally providing some figures to share. Feel free to give some hypotheses as to why your experiments worked or not worked.

Assessment: Effective assessment is very valuable tool and yes it works wonderfully. Here is my experience briefly. I wanted to know the answer to two key questions that I believe will improve physics learning, Question 1: What do students find more difficult to learn, concepts or solving physics problems by plugging in numbers in equations. Question 2: why do students have basic misunderstanding on fundamental physics concepts and/or why they get these concepts wrong despite repeated explanation and examples? To learn about these questions I designed an assessment method based on 1) Social Homework and 2) Peer learning which included iclickers, scantron item analysis, in class group quiz and problem solving exams. The result was better than I anticipated and as I mentioned before performing careful assessment was an extremely good idea. Using Social Homework I gave problems from Force Concept Inventory test prepared by the American physical Society to test students understanding of concepts. Using in class group quizzes I gave problem that require using equations to solve based on the same conceptual questions to assess what students find easy to solve a problem. We have a lot of data since we (the course TA and myself) assigned more than 15 problems targeting to address these issues and not all of them will be discussed here. I have done preliminary gathering of some of the useful things I learned that would help me for future use. The first is, students struggle the most when a problem involves some concept in it and requires them to use equations as well. Such conclusion could seem trivial but without data analysis hard to see why most students miss questions of such nature. The second types of questions that students don't seem to get are those that require comparisons. Here is an example of a type of question missed by many students and that has the elements of the two sources of difficulties I listed. Q: A Pendulum on the Earth has a period T. The acceleration due to gravity on Mars is less than that on the earth, and the acceleration due to gravity on the Moon is even less. Where would the period of an identical pendulum be the largest? The question although I thought was on the easy side combines all of the difficulties students' have-it requires conceptual understanding, it requires the use of equations and further requires comparisons. After I did the analysis and saw the result, it was obvious to me why this question was the most missed. Again, very hard to arrive at a meaningful conclusion without careful assessment. I plan to compile all the data and use as part of my RTP assessment report.

Discussion. Would you do this again? Why or why not? Any tips or ideas for other faculty attempting to try this in their own classes? Do you feel that you accomplished something by being a part of the FLC? If so—what is it?

Absolutely! I will always do careful assessment and peer instruction by making use of all technological aids such as Social Homework, iclickers and not so technological group quiz. I am convinced that one can identify trends on what students find difficult and why? Once these fundamental patterns are identified then they can be addressed systematically for next time around. Followed by further assessment until the desired result is achieved.

I would like to say as Dean Kingsford does now require, I think careful assessment should accompany any instruction. Done carefully accompanied by technological tools that allow not only assessment but also peer instruction meaningful teaching improvement could be achieved.

I believe that designed experimentation of new teaching tools with a thoughtful assessment is a very good way to improve one as a teacher and I plan to do this the rest of my career. This conclusion to me is a big achievement.

Introduction
Bengt J. Allen
Biological Sciences
OSI 455 *Marine Ecological Processes* (CSU Catalina Island Semester)
Enrollment = 13 students
This is not typically considered a low completion rate course

Methods
I decided to try and improve my ability to teach students in this 4-week intensive upper division elective for Marine Biology majors to read, interpret, and evaluate primary literature by implementing the C.R.E.A.T.E. (Consider, Read, Elucidate the hypotheses, Analyze and interpret the data, and Think of the next Experiment) approach. C.R.E.A.T.E. is an NSF-funded project designed to promote the development of scientific thinking, data interpretation, and content knowledge (Hoskins et al. 2007).
Over the course of the class, students read and analyzed a set of four papers published in series from two competing labs that showcased the evolution of a research project over a period of years. They used a variety of tools to evaluate the material, including written summaries, visualization and sketching of experimental designs, and data transformation and manipulation. We spent time as a group focusing on both why and how the studies were done, examining the hypotheses underlying different aspects of the research and discussing the data in each figure and table. After analyzing a paper, students designed their own proposed follow-up experiments and then debated the relative merits of each proposal as a class. We then read the next paper in the sequence and evaluated what was done in light of the previous discussions.

I evaluated their progress by giving them pre- and post-C.R.E.A.T.E. assignments asking them to summarize and evaluate published articles not used in the module. I'm used two different papers that have historically been quite challenging for students in this class (Paine 1992; Worm et al, 2002). I randomly assigned each of the papers to half the class as the pre-assessment instrument; the other paper was then assigned for the post-assessment. This helped separate training-specific differences in student capabilities from article-specific differences. Scientific paper summaries were evaluated with the rubric presented in Table 1.

Finally, I administered a Self-Assessed Learning Gains survey to get information on the students' own perceptions of how their critical thinking and data analysis skills changed during the course.

Hypothesis
My expectation was that spending a significant amount of course time modeling the deconstruction and analysis of multiple published papers would result in student gains with respect to their ability to critically evaluate other papers on their own. By following a single line of research across multiple papers, students should accumulate significant knowledge and insight into that particular system, enhancing their ability to understand what was done and to propose logical extensions to the research.

Results
In general, this approach seemed to work. For both assessment papers summarized by students, scores were 17% higher on average at the end of the class than at the beginning (Fig. 1). The written comments were notably more detailed and specific at the end of the class, indicative of the students' improved ability to read and analyze complex scientific literature. Although the differences were not statistically significant at the 0.05 level (ANOVA: Article, $F_{1, 20} = 0.03$, $P = 0.872$; Reading Order, $F_{1, 20} = 3.24$, $P = 0.087$; Interaction, $F_{1, 20} = 0.11$, $P = 0.747$), this is likely due to low power associated with small sample sizes ($n = 6$ per group; one student was unable to complete the post-assessment summary) and an incomplete factorial experimental design.

Students also self-reported increased understanding of the nature of science and confidence in their own reading and analysis abilities (Table 2).

Discussion

Students participating in the CSU Catalina Island Semester take three upper-division Marine Biology courses and 3 units of Directed Research during the semester; however, rather than taking all courses concurrently, they take them sequentially. Courses that are semester-long when taught at CSULB are completed in only four weeks out on Catalina Island.

Overall, students read 15 papers during this class. My guess is that the compressed time frame may have limited potential gains exhibited by the students as they had less time to develop and apply their new skills than they would during a normal semester. Similarly, I was not able to implement all of the different C.R.E.A.T.E. strategies due to the shortened schedule. I am excited to try this again next fall, when I will teach the equivalent class (BIOL 455 *Ecology of Marine Communities*) on main campus. I am currently in the process of getting this course reclassified as an Integrative Learning and Writing Intensive GE Capstone. Reading scientific literature effectively will be a critical requirement for students in this class yet is one of the most difficult skills for them to develop. Any improvement in their ability to extract information from published research and put it into a larger conceptual framework will help them immeasurably, both in my course and in their professional future.

Participating in the CSULB CNSM Faculty Learning Community pushed me to try something new to improve student learning in my classes and gave me the resources to do it. In addition to the changes reported here, I'm also planning to try a new approach to testing in a large lecture class I teach (BIOL 350 *General Ecology*) next fall and am developing a Ecological Concept Inventory to assess student learning during the semester.

Literature Cited

Hoskins S.G., Stevens, L.M. & Nehm R.H. (2007) Selective use of the primary literature transforms the classroom into a virtual laboratory. *Genetics* 176: 1381-1389

Paine R.T. (1992) Food-web analysis through field measurement of per capita interaction strength. *Nature* 355: 73-75

Worm B., Lotze H.K., Hillebrand H. & Sommer U. (2002) Consumer versus resource control of species diversity and ecosystem functioning. *Nature* 417: 848-851

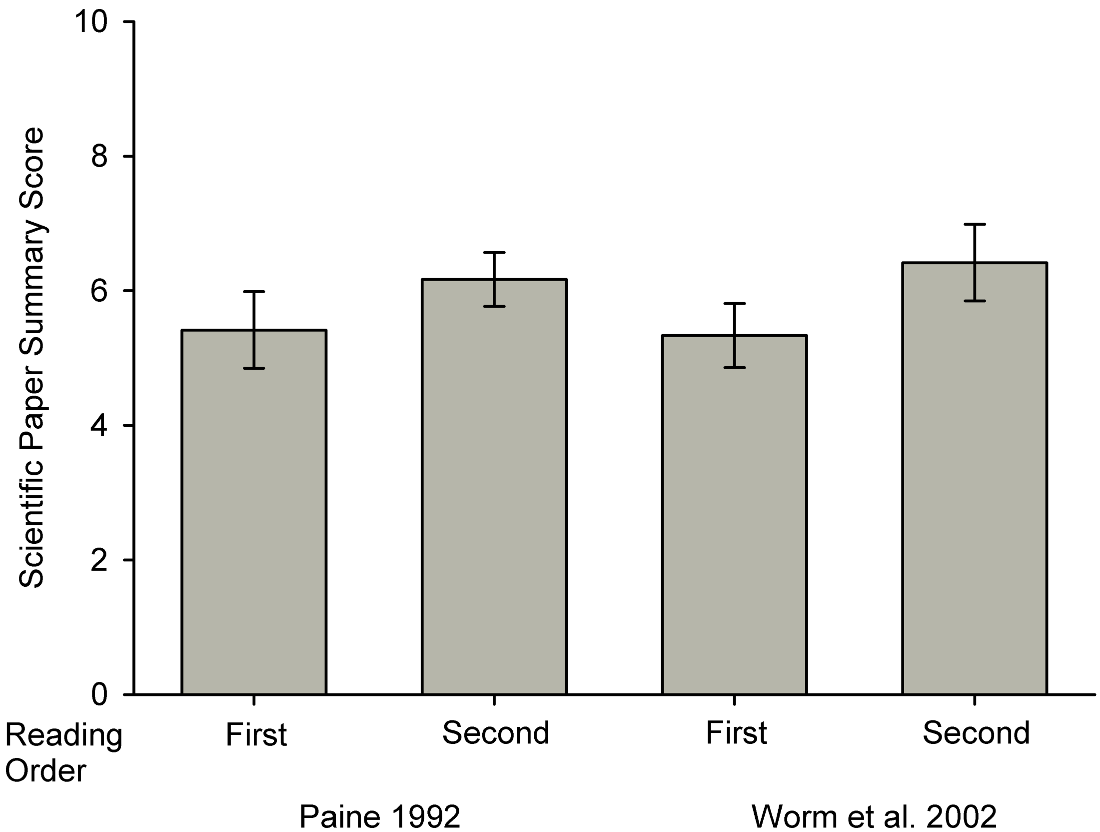


Figure 1. Scores (mean ± SE) for scientific paper summaries by students in OSI 455 *Marine Ecological Processes*, CSU Catalina Island Semester, Fall 2013. Students (n = 12 total) were assigned at random to read one of the two papers at the beginning of the class ("First") and the other at the end of the class ("Second"). Scores were assigned for their ability to summarize and evaluate the papers according to the rubric in Table 1.

Table 1. Scientific paper summary rubric, OSI 455 *Marine Ecological Processes*, CSU Catalina Island Semester, Fall 2013.

	Excellent	Very Good	Good	Fair	Poor	Score
Research Summary	*4 points* Clearly, concisely and accurately conveys the nature and details of the reported research	*3 points* Conveys a generally accurate sense of the nature and details of the reported research	*2 points* Conveys only a partial or very broad sense of the nature and details of the reported research	*1 point* Is inaccurate or provides little sense of the nature and details of the reported research	*0 points* Nothing	
Research Evaluation	*4 points* Clearly identifies critical strengths, limitations, and future directions of the research; provides evidence of critical thinking and/or information synthesis	*3 points* Identifies some strengths, limitations, and future directions of the research; provides evidence that the material in the paper was understood	*2 points* Incompletely identifies strengths, limitations, and future directions of the research; provides evidence of somewhat confused understanding of the material in the paper	*1 point* Inaccurately or fails to identify strengths, limitations, and future directions of the research; provides little evidence that the paper was read and/or understood	*0 points* Nothing	
Writing	*2 points* Overall writing style is clear, concise, focused, and well-organized; uses proper tense and voice and contains no technical errors	*1.5 points* Writing is generally clear and well-organized; contains occasional extraneous material and/or technical errors	*1 point* Some passages are unclear or confusing and the writing is less well-organized; contains extraneous material and multiple technical errors	*0.5 points* Level of writing below that expected of upper-division majors; visit to campus writing center may be beneficial	*0 points* Nothing	
					Total (10 points)	

Table 2. Post-course interviews: student comments about C.R.E.A.T.E. and its effect on their views of science and their own abilities.

Perceptions about science and scientists	**Scientific reading skills**	**Ability to "think like a scientist"**	**Confidence in your ability to do scientific research**
My perception about science has definitely changed. I realize now that it is a lot harder than it looks, and while the job of a scientist may look straightforward (do this experiment, write what happens) there is a lot more to it than meets the eye. Scientists cannot just be experts in their field but must have a very broad range of skills.	I definitely feel that reading as many papers as we did has enabled me to read a paper and quickly summarize the main points and how I feel about the authors approach.	Because we read so many papers I feel that I can accurately approach a scientific question and answer it. I feel I can see flaws in logic and predict problems with the outcomes of experiments before beginning them (not perfectly or always of course!).	I received a huge boost in confidence when it comes to research. I still have ALOT to learn but I know now that I am capable of starting with a question, designing a project, and finishing it. Reading all those papers in preparation helped keep me on track throughout the whole process.
I found it interesting that you could “comment” on a paper that you were on the opposing side of.	I think my scientific reading skills definitely improved. I learned the importance of picking apart the methods and how that can help understand the conclusions much better. I believe I have a much better approach to sitting down and reading a paper.	I think this also improved, I am asking more questions when I read papers and I am realizing its okay to not agree with how someone did something or what they concluded.	I love doing research and I know its what I want to do. My tough part has always been coming up with what my research means, however I feel like I am now able to make conclusions that I feel confident about.
I have a more realistic and less romanticized perception of science and scientific research, which is something I needed. Now I have a much better understanding of what it takes to be a research scientist.	I am much better at reading papers now. Before it would take me hours to get through one and at the end I didn't even remember what I read. I am much better at extracting information out of papers now.	I find myself thinking like a scientist a lot just, even about everyday things. And when I read papers now I can feel my gears turning in my brain to critically think about the experiment at hand.	This program has truly put into perspective every part that goes into a research project and how to present the material in a sophisticated manner.

Introduction

- Judy Brusslan
- Biological Sciences
- General Genetics, BIOL 370
- 168 students
- Not a low completion rate course

Hypothesis

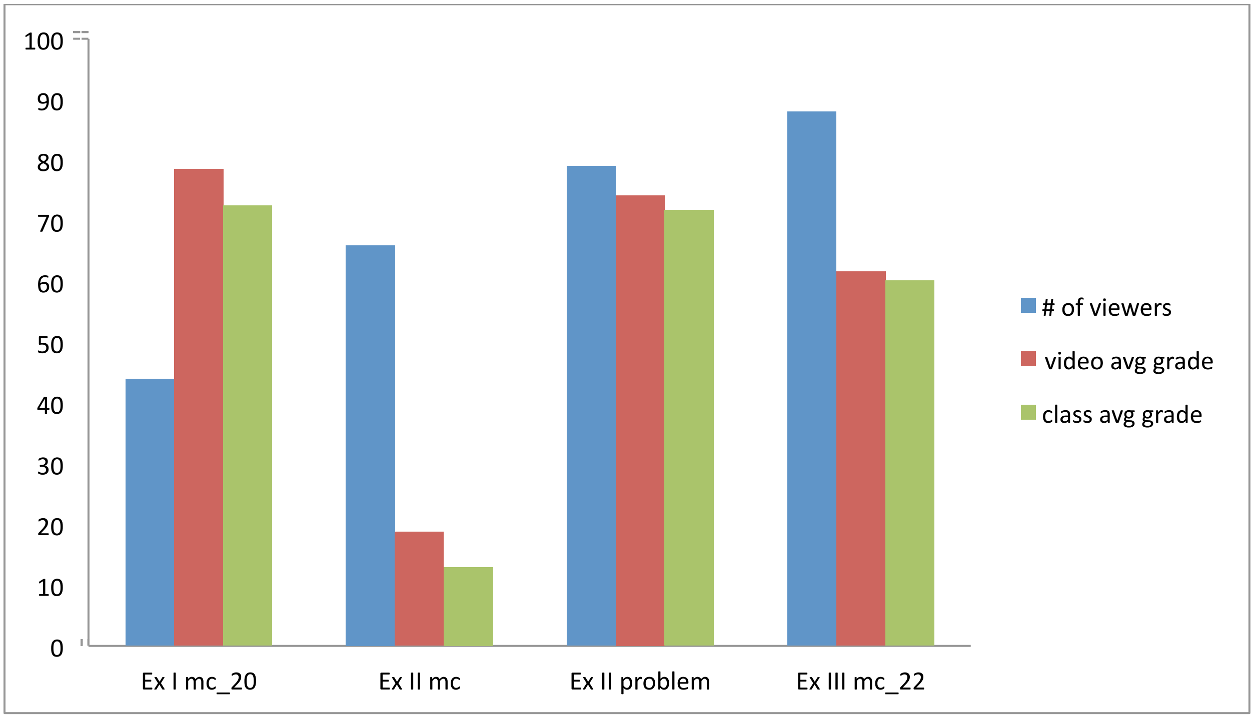
General Genetics exams are approximately 80% problem solving. I thought that the most helpful tool to provide to students would be video presentations where problems are solved, so the step-by-step process and fundamental logic of each step could be explained and reviewed. I have a tablet PC where I can write on the screen in a PowerPoint file, and this can be recorded and uploaded to BeachBoard using Panopto, which records my voice as I solve the problem. The uploaded videos each covered a problem that had been done in class or assigned in an online quiz or as homework. Students could review my explanations, since it can be difficult to follow each step during class. Also, many of these problems are difficult, so having the ability to review the process of solving many times might be helpful. Watching videos was not required. I did not choose to do the standard flipping of the classroom because I felt that the most helpful tool would be problem-solving videos.

Results

The problem-solving videos were highly successful. First, the number of viewers increased during the semester from 44 to 89 of 168 students between Exam I and Exam III. These numbers are shown in blue in the bar graph below. To assess the effectiveness of video viewing, I used one challenging multiple choice question from each exam as well as one written problem from Exam II. I then downloaded the email addresses of viewers from BeachBoard, correlated these to student ID which was used to find the score from the ParScore summary sheets. For the written problem, I recorded grades using a hidden column in the BeachBoard gradebook. I then compared average scores of video viewers to those of the entire class. As can be seen in the bar graph, video viewers had consistently higher scores, from 1.39 to 6.06% points. This could be due to the videos being helpful OR to the confounding variable that more motivated students were watching videos. At this time, these two factors cannot be differentiated. Regardless, the feedback from students who watched videos was overwhelmingly positive, and an increase in viewers suggested students found the videos to be valuable.

Discussion

- I will continue to use problem-solving videos in General Genetics.
- The videos ranged from 4-8 minutes; longer videos would not be viewed by busy students. Also, I only made videos on difficult material as easy material can be figured out by students.
- I really enjoyed making the videos and seeing them used. As the semester progressed, students would email requests for videos, suggesting they found them to be valuable. Being part of FLC motivated me to try new technology AND to do the assessment. It also helped me understand students' time constraints as well as thinking about tools that students would consider the most useful.


100
90
80
70
60
50
40
30
20
10
0
Ex I mc_20
Ex II mc
Ex II problem
Ex III mc_22
# of viewers
video avg grade
class avg grade

Introduction

- Name: Will Murray
- Department: Mathematics and Statistics
- Class: MATH 123H, Calculus II Honors
- Students: 26 (initially enrolled; 22 completed)
- Standard MATH 123 is a low completion course; in fact, it is one of the lowest at the university. MATH 123H has not been taught since 2005. When it was last taught in 2004 and 2005, the passing rates were 70.6% and 69.6%. The passing rate in my 123H this semester was 80.8%. However, all of these courses were relatively small (17-26 students), and many other factors have changed since then (such as the introduction of online homework), so we should not read too much significance into these percentages.

Hypothesis

I had the students give parts of my lecture on certain selected topics. These were not presentations on projects the students had done, but actual lectures on (mostly) core material for the course. I gave them detailed outlines of what material to cover, leaving them to fill in computational steps. Other students were expected not just to listen politely, but to learn the material presented by their peers, and I tested this with homework assignments and quiz and exam problems covering the material.

I was hoping that having students give lectures would increase their engagement (both when giving the lectures themselves and when observing their peers instead of me), stimulate their interest in the material, and generally promote their learning. I was also hoping to be able to cover some topics not normally covered in MATH 123. Finally, I hoped that students would learn more of the true nature of math by having to organize and present a topic coherently rather than just solve lists of problems.

Homework Data

Average on written homework from the student lectures: 87.3%. Average on online homework: 90.6%. However, students had multiple attempts and instant feedback on the online homework, so they could try multiple times until the computer confirmed their answer. On the written homework, they didn't have multiple attempts, so I think the fact that their scores were almost the same represents a significant success.

Quiz Data

Average on quiz problems drawn from the lectures (and the corresponding written homework): 80.3%. Average on quiz problems drawn from the online homework: 81.0%. Statistically, there isn't a significant difference here. However, I think students probably had more chances to practice the online homework problems and fewer chances to practice the topics covered in the lectures, so I think the similar scores speak well for the lecture format.

Exam Data

Average on exam problems drawn from the lectures (and the corresponding written homework): 61.3%. Average on exam problems drawn from the online homework: 61.9%. Again, statistically, there isn't a significant difference here.

Positive Results

My experiment met with mixed results. On the positive side, we were indeed able to cover some material not normally covered in MATH 123, and I think students saw some of the joy in math. Students did very well preparing the content of their lectures; they had no problem filling in the computational steps and they confirmed with me ahead of time to make sure they were all correct. Both lecturers and audience did learn some lessons about the true nature of math. (For example, the definition of the cosine function is not "whatever the cosine button on my calculator tells me." Rather, cosine has an intrinsic definition and we should learn how the calculator computes that value.) However, I stressed these lessons repeatedly even outside of the student lectures, so I can't honestly say that the lectures were solely responsible for the lessons.

Students did pay respectful and supportive attention to their peers during the lectures, and they largely performed well on the corresponding homework assignments and tests. This shows that they did indeed learn the material, although as I will explain below, I think most of the learning occurred outside the classroom rather than during the lectures themselves. (Of course, this is probably true of my own lectures, too!)

Negative Results

I sat as a student in the class during the student lectures, and I found it to be incredibly uncomfortable, mostly because they were, by professional standards, terrible. Students faced the board the entire time, mumbled their way through the material, blocked the view of the board from their audience, went way too fast, and had illegible handwriting. Most seriously, they often utterly missed the point of their lectures (even while getting the computations correct) and they almost always completely failed to engage their peers in the material.

We had two discussion sections, a tiny one of seven students followed by a busy one of 18, so each student gave her lecture twice. I hoped this would give them a dress rehearsal, followed by some time to reflect, and then a polished second run. In reality, although a few lectures improved based on my feedback after the first delivery, most students made exactly the same mistakes again in the second show.

I think the students watching were mostly hopelessly lost; the lecturers just didn't engage them enough to let them catch up. The audience usually either gave up completely, or tried unsuccessfully to follow in silence. They very rarely asked questions, either because they had no opportunity or because they didn't want to derail their peers who were struggling themselves to get the material onto the board.

In retrospect, much of this was predictable, and most of it is my fault. Although I prepared them well with the mathematical content, I didn't give them nearly enough guidance on presentational style. I shouldn't have expected college freshmen to present difficult material like pros; I should have spelled out the details of what I was hoping for and backed it up with a serious grading policy. (I didn't want to stress them out too much, so I gave them all full credit on their presentations.)

To give them better guidance about how to present mathematics would have required prior preparation and a written grade sheet with scores in various categories: audience engagement, eye contact, pacing, etc. These issues seem obvious to me after teaching for 12 years, but I should not have expected them to come instinctively to nervous students presenting difficult material the first time.

Discussion

I would try a similar idea again, and I would encourage other faculty to try it too. However, I and others should certainly learn from what worked and what didn't in my experience. Giving them serious homework, quiz, and exam questions based on the lectures definitely worked. Throwing them into lecturing without lots of guidance and detailed written feedback didn't. As suggested above, I should have given them significant training on this, written a detailed evaluation sheet, let them see the evaluation sheet in advance, and then followed through on it.

FLC overall was a very positive and motivational experience for me. In general, it really encouraged me to experiment with new ideas in my classes, recognizing that some will succeed and some will fail but that we can learn from both and take good ideas and suggestions from both. More specifically, I learned much about how my current students are different from those of even ten years ago and how teaching and learning occur differently even in seemingly closely related scientific fields. Most importantly, I got lots of great specific ideas from the online readings and from my peers' posts. I'm excited to try more of them in my classes in the future!

Introduction

- Nate Onderdonk
- Department of Geological Sciences
- Geol 339- Introduction to Geomorphology
- Number of students in the class: 10
- This is not considered a low-completion course

Hypothesis
The hypothesis that I tested was: that a flipped-lecture format would result in better student learning because it would allow for more teacher-student interaction during assignments meant to give the students practice applying concepts and techniques from the lecture.

Background
Geomorphology is an upper division elective course (currently being considered as a required course for the geology major) that is typically taken by Geology majors, Environmental Science and Policy majors, and Geography majors. I teach the class every fall semester and incorporate a lot of hands-on learning in the form of labs, field trips, in-class or take-home assignments, and a final project.
I have designed the class content, exercises, evaluations, and grading structure to emphasize the application of concepts and tools presented in the class. In previous years, I have noticed that students learn more during the labs than the lectures and that they usually perform better on exam questions that address concepts presented in labs, than things covered only in lecture. So I wanted to see if a flipped-lecture format that would allow more time for in-class assignments would increase student learning.

Methods
I have the course broken up into three sections, each covering different aspects of Geomorphology and each culminating in an exam. I decided to "flip" one section to see if the students did better on the exams from that section, and to compare to previous years, using the non-flipped sections as a control.
The flipped-lectures consisted of online lectures (about 20 min long) using Panopto, and the students were required to turn in an outline at the start of class to ensure that they watched the video.

Time in class was then used to do exercises as a group that forced the students to apply the principles and practice the tools presented in the lecture. One example: after learning about the types of landforms that are created by recent faulting, the students used GoogleEarth to map such landforms along a portion of the southern San Andreas fault in southern California.

Results
My qualitative impression from that class was that the flipped-format worked great. I felt like the students understood the concepts better by the end of lecture because they had more time to interact with me and other students while putting the concepts into use during the class exercise. During the in-class exercises I could see them helping each other, figuring stuff out, and actually understanding ideas that were presented in the online lecture that they obviously had not completely understood from the lecture alone. Although some of this would take place in a normal format, with the students working on these exercises on their own as homework, I seriously doubt that they would have grasped as much as they did in class with me and their other classmates present. I have often been shocked by how far off they are on homework assignments or labs that they work on independently after I have given them a lecture that I felt clearly explained and laid out a concept or skill or approach. There is certainly a difference between what they think they understand at the end of one of my lectures, and what they understand after using the ideas in an exercise.

Qualitatively, the exam and lab scores do not show as clearly an advantage to the flipped-lecture format. Below is a table showing the average of student scores on exams and one lab (that dealt with the material in the flipped-portion of the class) from 2013, 2011, and 2010 (I did not teach the class in 2012). The numbers in bold are the scores related to the flipped-format lectures.

	Exam 1	Exam 2	Exam 3	Tectonic Lab	Final Grade
2013	72	83.8	**70.9**	**88.2**	**86.73**
2011	70.45	71.6	68.8	N/A	85.98
2010	61	72.83	68	74.5	80

The students in the fall 2013 class scored better on the evaluations that covered material covered in flipped-lectures (Exam 3, Tectonic lab, Final Grade) than the students in 2011 and 2010 on the same exams. This suggests the flipped-format increased student learning. However, the students in the 2013 class also did better than the 2011 and 2010 class on the evaluations that covered material that was presented in the typical lecture format (Exams 1 and 2). So it is possible that the students in the 2013 class were just a better group of students, or that my teaching has improved, and the flipped-lecture format had nothing to do with it.

As I mentioned above, my general feeling is that the flipped-format increased student learning, but based solely on the students' scores, there is no clear proof that this is the case.

Discussion

I will definitely use this flipped-lecture format in the future. Although I will probably use it for only parts of a class, because I think it is most appropriate for lectures that present techniques and problem-solving approaches. I also liked the fact that it guaranteed the students did some work outside of class on a daily basis. I am sure that many do not always do the assigned reading, and probably do problem sets at the last minute in a rush. The students also seemed to enjoy the in-class time working with the new concepts and I enjoyed being able to interact with them more and see what concepts were hard and where the sticking points were.

I gave the class a survey at the end of the semester about the flipped-lectures and got some really good feedback. About half preferred the flipped-lecture format and half preferred the traditional way. Below are some of the pros and cons the students listed:

Pros:

1. Forced them to do some work outside of class and come prepared.

2. Allowed them to work at their own pace with the online lectures since they could stop it, rewind, or watch it again later.

3. Some liked that they could copy and paste figures from the lecture into their notes.

4. They got to "learn the material twice". Once in the lecture, and then playing with the ideas in class.

Cons:

1. The online lecture was “One more thing to do in my already busy schedule”

2. Can’t ask questions, or hear other student’s questions during the online lecture. Hard to remember the questions they had when class time came.

My tips for other faculty considering using a flipped-lecture format would be:

1. Make sure the lectures are up online well ahead of time. The students got upset when I put a lecture up less than 24 hours in advance even though most watched them the night before class or in the morning before class.

2. Use this approach only for material that you plan to work with in the following class period in the form of an exercise. Because the students can’t ask questions during the online lecture it is important to re-visit the concepts in another way (hands-on learning) in class to make sure they got it.

Yes, I got a lot out of the FLC. I thought the first semester was great- learning about new ideas and approaches and hearing what other faculty were trying. I started incorporating ideas I heard right away and thought some worked really well. I am constantly trying to improve my teaching on my own, but having some “support” and talking to other faculty is really helpful. I wish that we could have met more often, or if there was time set aside to visit each other’s classes to see other people’s approaches and get feedback on my own teaching from other faculty.

Introduction

- Michael Peterson
- Physics & Astronomy Department
- PHYS 152, #5431, Section 2, Electricity & Magnetism
- 178 students
- This is not a low completion rate course

Hypothesis

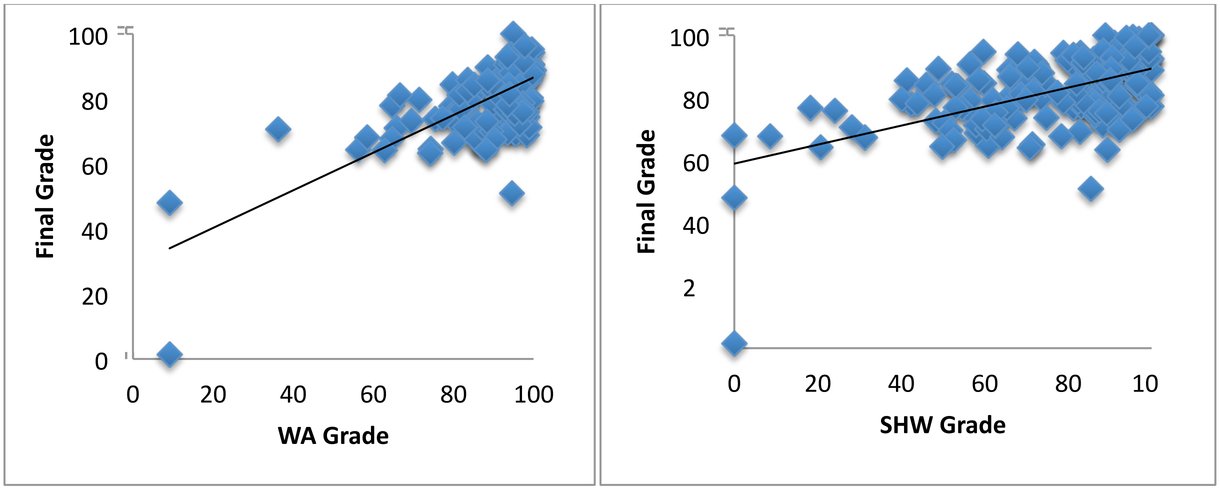
I introduced Social Homework to address the following student learning outcomes to varying degrees: quantitative reasoning, critical reasoning, and teamwork. In particular, it was aimed at promoting group discussion, more practice solving problems, and peer instruction, all of which are thought to increase overall learning. Ultimately, it was hoped that Social Homework would help the students transition into more mature problem solvers that use experienced approaches and become less reliant upon pattern-matching, formula searching, and other inexperienced methods.

Social Homework was a series of eight assignments (approximately one every 2 weeks) implemented by using the Social Homework website developed recently in the Physics & Astronomy Department by Profs. Gredig and Zlousek (Prof. Kisiel from the Science Education Department is also a close collaborator). Students worked in groups of five with predetermined roles (director, researcher, executor, and 2 skeptics) on various problems. Some problems were difficult and open-ended and some assignments were simply to choose a problem from the WebAssign homework and work out a detailed solution. The intention was to provide a collaborative and safe environment for students to discuss in greater detail concepts and ideas covered in lecture. It was also hoped that this environment would foster a sense of belonging for those students that might feel out of place, i.e., under-represented-minorities.

Results

At this point it is not clear to me that Social Homework worked completely. I was using the system for the first time, obviously, and needless to say, many glitches with the system and my use of the system remained. Many students had trouble signing into the system, understanding what the goals were, clearly understanding the grading rubrics, etc. However, anecdotally I observed a few key things. One was that I received many comments from students that they enjoyed the group work and felt the problems added value to the class. Of course, I also had students complaining about unenthusiastic group members and the idea of group homework being "socialist!!!". I personally noticed that some of the students are capable of more than I previously thought. I assigned a difficult problem that was solvable in a straightforward way numerically or required mathematics slightly beyond the scope of the course. Many groups surprised me by completing the problem analytically. I wonder if they are generally capable of a more sophisticated approach to the whole class?

I have not had sufficient time to analyze all the data coming out of my first attempt at implementing Social Homework so only provide two graphs. Additionally, this first implementation was fraught with many difficulties such that I do not believe the data will yield much real information. I will be working more on analysis in the future as well as joining with Prof. Kisiel who administered a couple questionnaires during the semester.



The above graphs, however, show the following. They show the correlation between the student's WebAssign grade versus their final class grade (left plot) and the student's Social Homework grade versus their final class grade (right plot). The lines are best fit lines and clearly there is a stronger one-to-one correlation between the students WebAssign grade and their final grade.

It will be important in the future to investigate in more detail the effect of Social Homework. The answers to Prof. Kisiel's questionnaire will yield interesting results regarding student's feelings of inclusion, etc. Further, a full analysis of the BEMA (Brief Electricity and Magnetism Assessment) and CLASS survey (Colorado Learning Attitudes about Science Survey). I expect the Social Homework to impact the CLASS survey the most by hopefully exposing students to a more mature way to think about and do science.

Discussion

I will be using Social Homework again in the Spring semester in the Honors section of PHYS 152. This class will be much smaller and have a different population of students so the effect might be very different. However, I have learned a great deal about the ins-and-outs of using the Social Homework, i.e., I have ironed out problems with registration, developed a number of assignments and problems, and know better how to explain the importance of Social Homework and where and when to incorporate assignments into the broader class structure.

My main tip for anybody trying Social Homework would be to take a sufficient amount of time explaining the purpose to the class. Additionally, one needs to explain grading rubric. This is trickier than it looks because a savvy student with complete knowledge of the rubric can effectively "game the system" and get full marks. So, one needs to explain just enough without giving away the game. That being said, I believe the Social Homework offers a great platform to ask a lot of our students and get more out of them, i.e., get them to tackle and accomplish difficult problems that would be very intimidating if they faced them alone. In turn, these difficult and open-ended problems force them to either start thinking and working more like a scientist or simply not solve the problem at hand.

I do feel like I accomplished something being part of the FLC. I believe all teachers are interested in becoming better but often time constraints make it difficult to do much thinking or reading in order to improve. The FLC provides a community in which to engage in improvement and a peer group to turn to.

Introduction

- Name: Houng-Wei Tsai
- Department: Biological Sciences
- Name and number of class where development occurred: BIOL 213 Intro Ecology and Physiology
- Number of students in the class: 117
- Is this typically considered a low completion rate course: Yes

BIOL 213, Introduction to Ecology and Physiology, is the third course in the three-semester introductory biology sequence designed for both majors and minors. This course introduces students to the structure and function of organ systems across a variety of taxa, and the ecological interactions among these organisms. BIOL 213 serves approximately 120 students per semester, and the class meets for two 75-minute lectures and one 3-hour laboratory each week. The lectures are split into two components, ecology and physiology. I have been teaching the physiology component of BIOL 213 since 2010.

At CSULB, most introductory science courses, including BIOL 213, share a similar format, a large student enrollment and generally 2-3 lectures per week taught in a large lecture hall. Physiology is often by nature a challenging subject for many students because of the volume and depth of information necessary to learn. In addition, large class lectures are also significantly challenging to students' learning in part due to dissatisfaction with the quality of large class learning experience:

- There is a lack of interaction between faculty and students because the instructor is unable to know the students intimately and provide individual attention;
- Students hesitate asking questions in class as indicating a lack of knowledge;
- There is a lack of or poor discussion sections in class.

Like many teachers, I believe that office hours are one of the best ways for students to get to know me, and I consider the time spent in one-on-one meetings with students as one of the most important opportunities for teaching. There are several reasons why office hours are worthwhile for both teachers and students. First, instructors and students get to know each other better. This personal interaction helps to break down the inevitable distance between teachers and students in classrooms. Second, office hours provide the opportunities to have a detailed discussion on questions and topics introduced in class. Last, the teacher can get some feedbacks about how students are responding to the course.

Therefore, I have always set up regular office hours after my lectures for students to approach me and ask for help, and repeatedly invited students to come to my office hours. Occasionally, my office hours had long lines of students, especially after the exams. They came to check their grades and exams. However, I am often left alone in my office most of the time. I have been considering and searching for the reasons why students do not attend my office hours more regularly. Some students are concerned that they won't know what to talk about, and the others worry that their questions may seem stupid. In an effort to improve attendance and usage of office hours, I introduced online help and discussion sessions into BIOL 213 this fall, using the web-based communication platform, Online Rooms (Collaborate), on BeachBoard.

Hypothesis

Brief (few sentences) description of what it is that you tried and how you thought it might increase student learning/success/retention. If you tried several things, organize as best you can to be clear.

I hypothesized that through the use of technology, the online office hours would increase the effectiveness of out-of-classroom help for students by:

- Allowing students to remotely ask questions;
- Engaging students to more actively participate in discussions with the instructor and amongst themselves;
- Sharing and addressing similar questions and points once to allow more topics discussed;
- Providing students the continuous access to their personalized discussions and other conversations taking place during and after the office hours;
- Allowing for "higher throughput in helping students.

Results

- *Did it work? Did it now work? Briefly describe your results- ideally providing some figures to share. Feel free to give some hypotheses as to why your experiments worked or not worked.*

Starting on October 17, 2013, I began holding real-time, online help sessions from 5:30 to 6:30 PM on Thursdays for BIOL 213 students during this fall semester. After connecting to BeachBoard, students clicked the name of the room. As prompted, their computers would download and opened the meeting file, with loading Java. The Java screen appeared and started the Blackboard Collaborate web conferencing software. Students would find themselves in a program resembling a traditional chat room, but with a window (whiteboard) showing what I was seeing on my computer. Students could "raise their hands" with the click of a button to chat with me and the other students via text or microphone. I selected Whiteboard to upload my handouts in PowerPoint files and display them in the Audio and Video window. To demonstrate programming concepts, I could even have the option to take control of a student's computer and operate it remotely. I virtually “hanged out” on Online Rooms for a whole hour, allowing students to enter and leave as needed. Meanwhile, regular office hours were held simultaneously, so the option of face-to-face interaction remained available for the non-tech-savvy students to make it in person. I recorded and archived these online sessions on BeachBoard for future playback, which allowed learning to go on after the office hours as well as for busy students who were unavailable during the actual office hours. Because all students could watch and participate in the discussion, similar questions and points could be addressed once, and so I would be able to discuss more topics in the allotted time than I could normally do with traditional office hours.

During this fall semester, I totally offered 6 online office hour sections. In the first section, there were only two students joined me on Online Rooms; one came to my office in person and the other participated in discussion online. For the second, third, and forth sections, there was only one student attended in person. Unfortunately, for the last two online sections, no students showed up. As compared with traditional office hours, I didn’t see a larger turnout for the online sessions with increased communication with students as I expected. Overall, students hardly showed up online during virtual office hours, suggesting that my idea about online office hours didn’t work for BIOL 213 this fall.

Discussion

- *Would you do this again? Why or why not?*
- *Any tips or ideas for other faculty attempting to try this in their own classes?*
- *Do you feel that you accomplished something by being a part of the FLC? If so—what is it?*

With searching the internet, I have found that virtual office hours have been widely used at online universities and are slowly being adopted by some brick-and-mortar institutions, such as the Harvard University (http://www.insidehighered.com/news/2007/09/18/officehours) just as these traditional colleges are starting to offer courses online for students. Based on their reports, they observed a much larger turnout for the online sessions as compared with traditional office hours, with greatly increased communication with their students. At the same time, their surveys of student opinions showed that students were overwhelmingly positive in their response to the online office hours.

In view of my unsuccessful experiment and those successful examples, I have found several possible reasons why my online office hours didn't work this fall. One is that students were not informed the availability of online office hours until the middle the fall semester when I began to teach BIOL 213 and announced this option in my first lecture. Students didn't expect this and couldn't plan to attend online office hours. Another reason might be anonymity. One student told me that she feared that her classmates would be able to connect her questions or opinions back to her to if she asked questions online, which made her embarrassed. For those successful examples of online office hours, an important ingredient reported is the ability for students to remain anonymous throughout the session, in which students could relieve their anxiety and feel free to "take risks" without having the fear of looking foolish in front of their peers or professors. Thus, the anonymity of the sessions might encourage students to more actively participate in the discussion while others chose a more passive role and still gain from the session.

In addition, I also have a small concern of losing access to visual communication with students because the instructor doesn't actually see students online. With the lack of traditional, face-to-face situation, the instructor cannot use eye contact, facial expressions, or other physical means, such as hand movement, to assess student understanding or add emphasis to his/her explanations. In summary, my experiment with introducing the online sessions has left me with many interesting questions about their use in enhancing student learning. I plan to continue improve the way of administrating online office hours together with traditional office hours and make them available for my courses this spring.